
**Pad ICD Changes
for
Modified GH2 Vent
Ice Suppression Shroud
CR S063347/IRN KO-2125
To ERB**

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Agenda

- Background
- ET GH2 Vent Umbilical Overview
- Development Testing
- Modified Shroud Configuration
- Installation Photos
- Requalification Testing
- Conclusions
- Recommendation
- Backup
 - ICD Changes

Background

- During the STS-114 tanking tests, launch attempt and launch, the ET GH2 Vent Ice Suppression Shroud formed Ice and Liquid Nitrogen.
 - Investigation Problem Report (IPR) 114V-0361 and IFA STS-114-I-014 were generated



System Overview

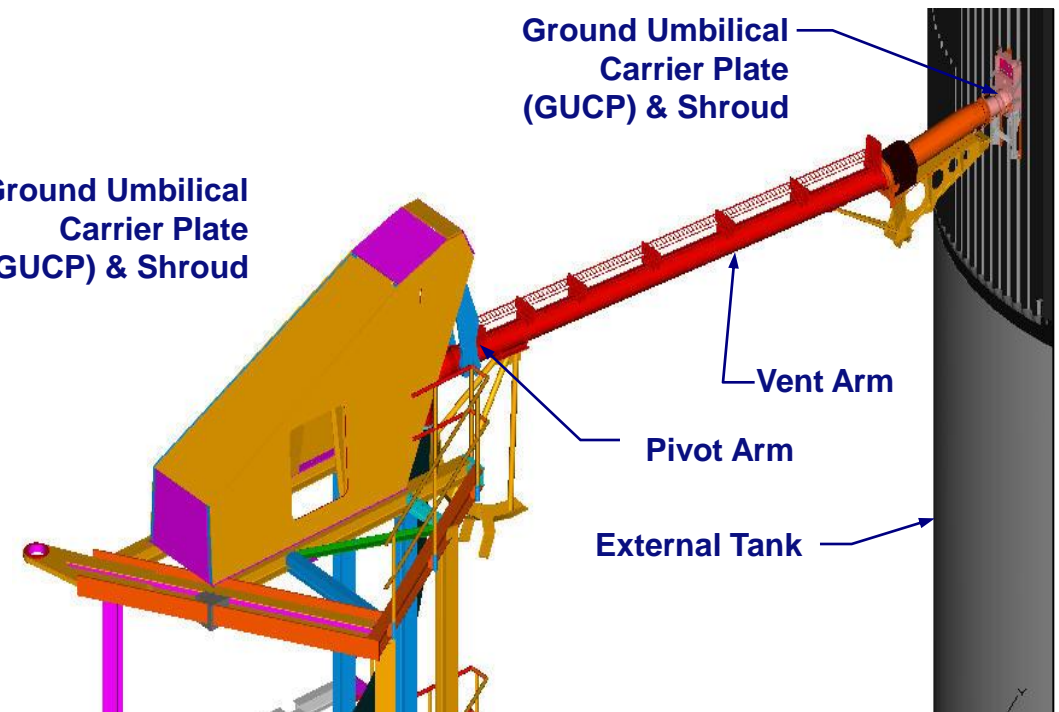
- ET GH2 Vent Umbilical System
 - Provides GH2 venting from hydrogen tank
 - T-0 quick disconnect operation



ET GH2 Vent Umbilical

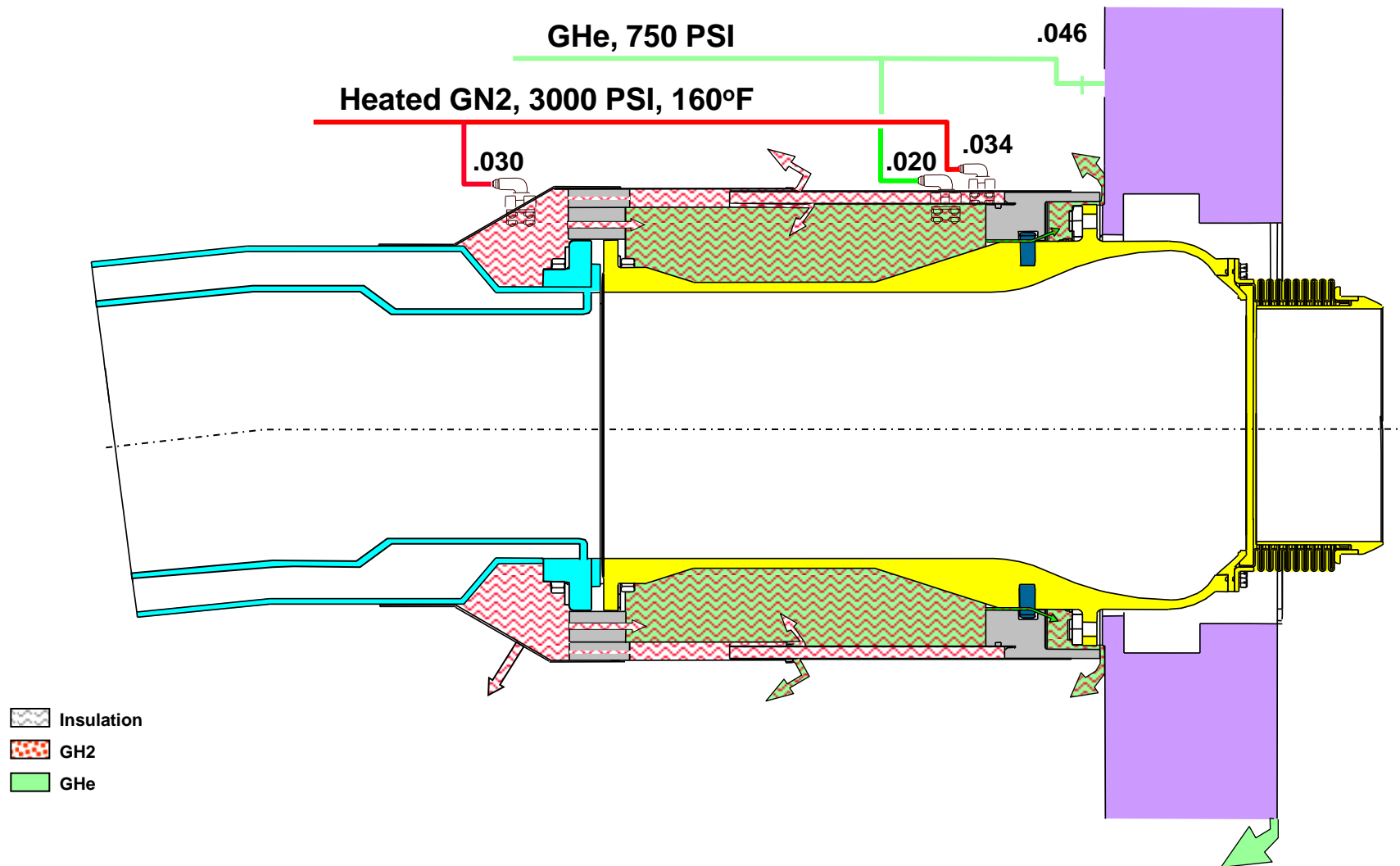


Ground Umbilical Carrier Plate (GUCP) & Shroud



Old Shroud Configuration

- Flow path of commodities (GN2 & GHe) in GH2 vent shroud

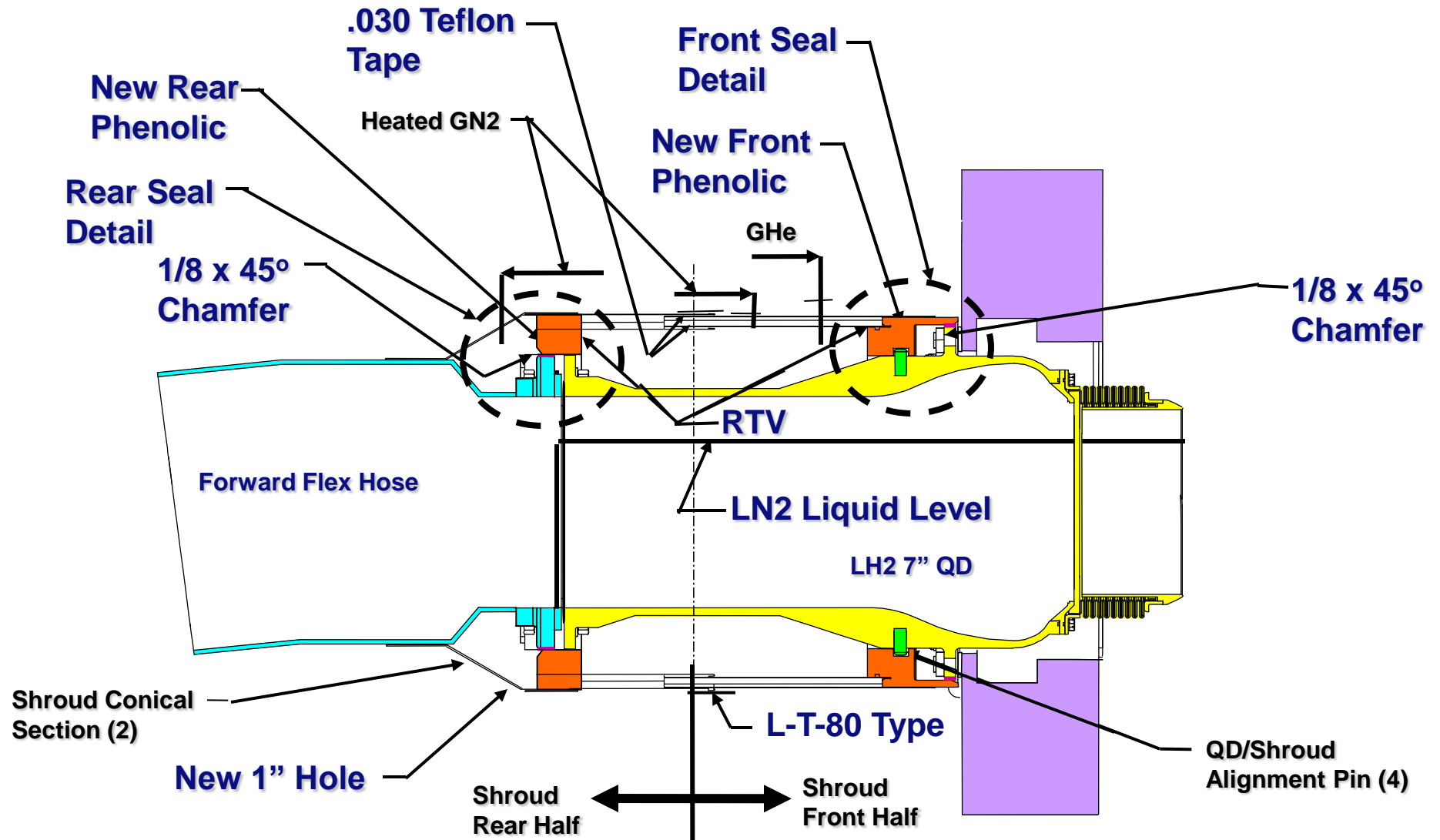


Development Testing

- The shroud was modified and went through a series of LN2 development tests at the NASA Cryogenic Lab & Launch Equipment Test Facility (LETf).
 - Development tests determined the following
 - Best seal material & configuration for the GHe and both GN2 annulus
 - Size the purge vent holes in the phenolic rings
 - Size of purge vent hole in rear conical portion

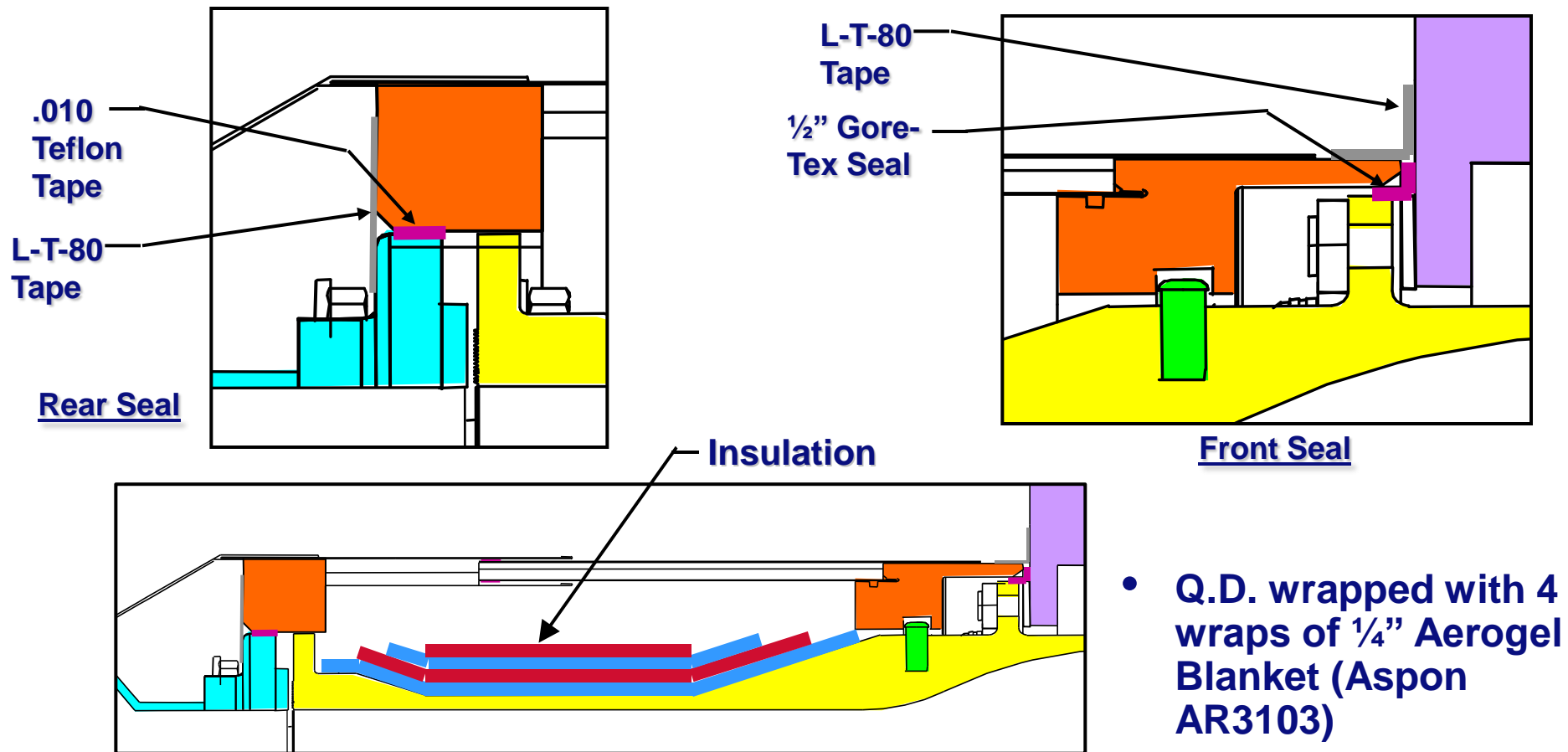


Modified Configuration



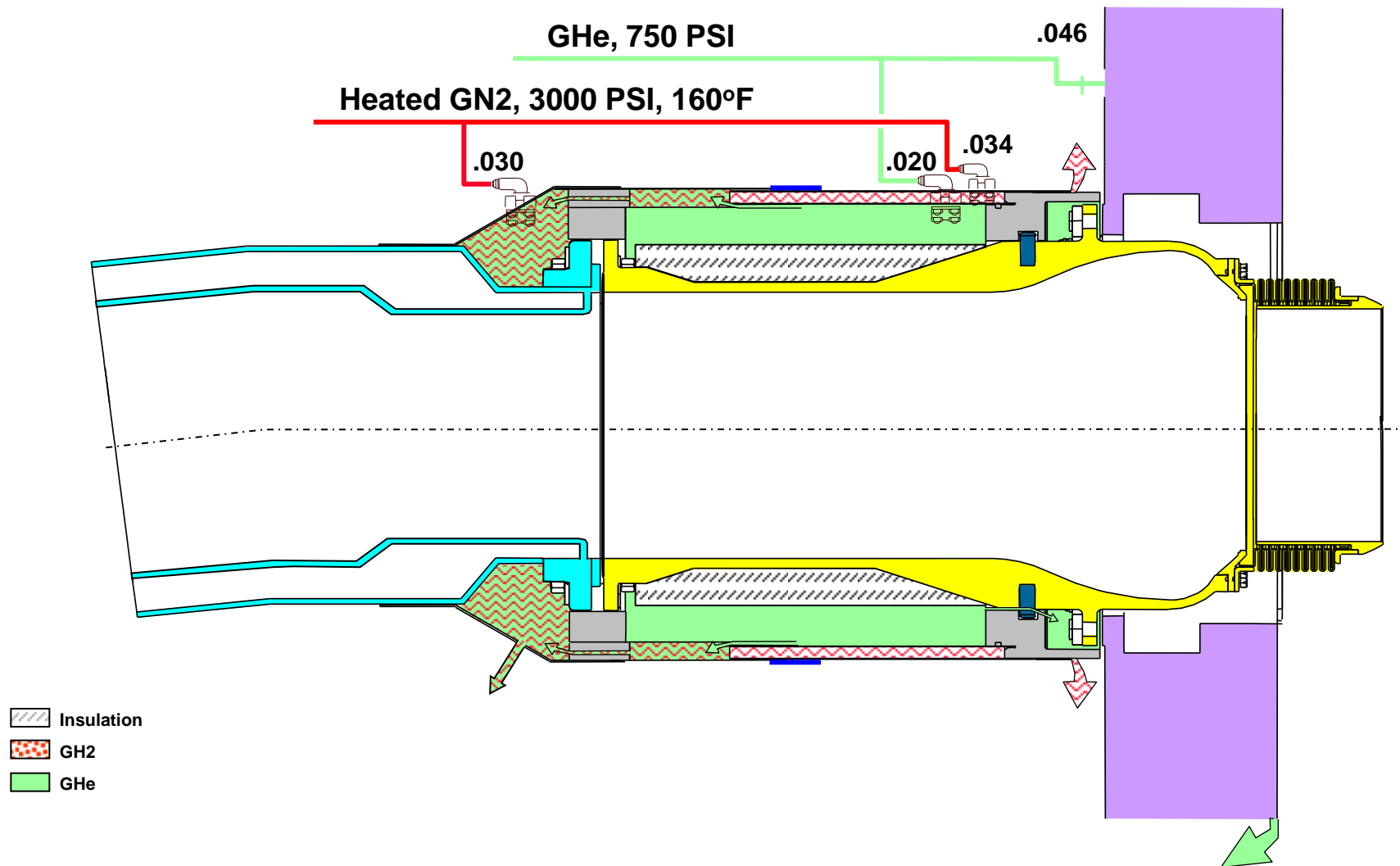
Modified Configuration Details

- Easy to install, No new installation tools required
- Front Seal is partially visible for inspection prior to applying tape
- Front and rear tape visible for inspection.

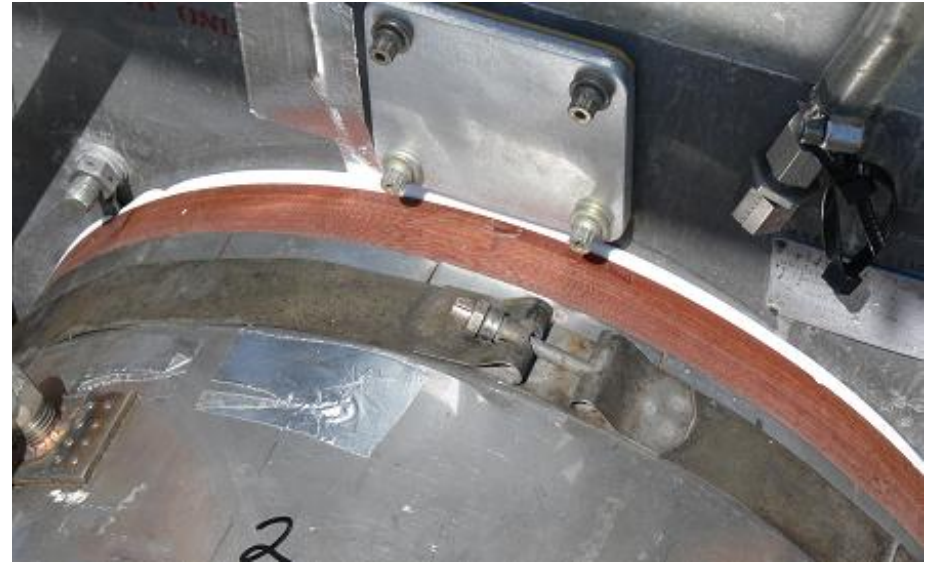


New Shroud Configuration

- Flow path of commodities (GN2 & GHe) in hydrogen vent shroud



Installation Photos



Requalification Test

- **Test Conditions**
 - Two Qualification Tests with final shroud configuration
 - 48 Hours minimum between test starts
 - Chill QD with LH2 for 5 Hrs
 - Misters on test article for 3 to 4-hours
 - No shroud re-mate between tests.
- **Test Results**
 - Test verified no to minimal GN2 entered the GHe annulus
 - Mass Spec & positive delta P
 - Test Verified no ice or frost can form on shroud
 - Temperature measurements on OD of shroud
- **Open Issue**
 - There was excessive ice on GUCP legs during LETF testing with misters.
 - Cause is most likely the test conditions, misters for 4-hours.
 - Analysis in-work by Lockheed Martin, ECD 5/3/2006.

Conclusions

- The new seals greatly improved the existing design which has supported many launches.
- New seals good for cryogenic conditions
 - Gore-Tex is good from -450°F to 600°F per vendor data.
 - Seals have have been tested @ LN2 temperatures @ 2-3X the nominal flow rate.
- Material used for modifications are good for launch pad environment.
 - Environmental exposure will not affect L-T-80 tape or Gore-Tex materials
- Operational impacts will be limited to installing the new insulation and seals.
 - The new seals and other improvements are controlled, therefore no special test equipment is required.
 - Visual inspection of seals and tape is adequate.

Recommendations

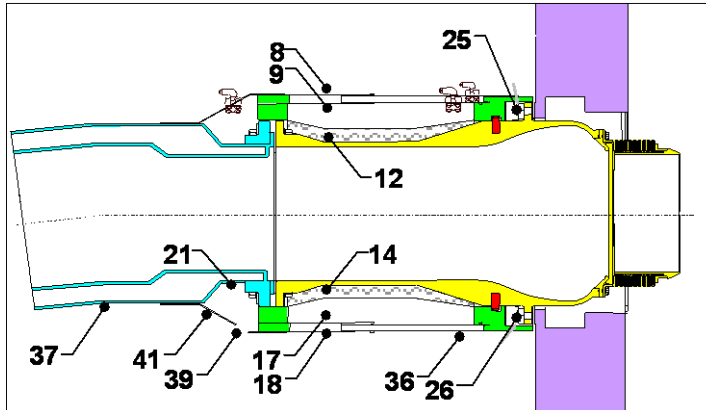
- Recommend approval of IRN.
 - Pending analysis results on GUCP ice during LETF testing.

Back-up Slides

Modified Configuration

- **Modified phenolic rings**
 - Smaller ID, 1/8 x 45° Chamber, GHe holes plugged, Front GN2 holes plugged
 - (2) 1/8" holes in upper rear GN2 phenolic
 - (18) 1/8" holes & (4) 3/16" holes in lower rear phenolic
- **0.020" GHe Orifice (Standard Launch Configuration)**
- **L-T-80 Tape installed on the Rear Cone (Standard Launch Configuration)**
- **L-T-80 Tape installed on outer telescoping section**
- **.030 Teflon Tape installed on telescoping sections**
- **RTV applied between phenolic and inner annulus metal**
- **Shroud forward seal configuration**
 - 1/2" Gore-Tex Tape applied to GUCP/Q.D. O.D. interface
 - Shroud sandwiches Gore-Tex between forward phenolic and GUCP
 - L-T-80 tape applied to shroud/GUCP interface
- **Shroud rear seal configuration**
 - .010 Teflon Tape applied to O.D. of flange of forward 8" flex hose.
 - L-T-80 Tape applied over rear phenolic/flex hose flange interface
- **1" hole added to bottom of shroud's rear cone section**
- **QD wrapped with Aerogel Blanket insulation secured with Mylar Wrap and Mylar tape.**
 - Covered with L-T-80 Tape to protect insulation from GN2 purge.

LETF Test Data



Description	Ambient Temperature (°F)	Humidity (%)	Wind (mph)
LH2 Test #3 @ LEFT	64	59	0
LH2 Test #3 @ LEFT w/misters	64	60	1
LH2 Test #4 @ LEFT	71	59	5
LH2 Test #4 @ LEFT w/misters	68	58	2

Measure Number	Measure Location Description	LH2 Test #3 @ LETF	LH2 Test #3 @ LETF w/misters	LH2 Test #4 @ LETF	LH2 Test #4 @ LETF w/misters
8	OD Shroud Rear 12:00	81	68	90	68
9	ID Shroud Rear 12:00	48	46	53	43
12	OD of QD Rear 12:00	-407	-409	-404	-406
14	OD of QD Rear 6:00	-406	-407	-404	-405
17	ID Shroud Rear 6:00	58	61	61	53
18	OD Shroud Rear 6:00	62	74	71	63
21	OD Flex Hose In Conical 6:00	-28	-28	-27	-25
25	QD Flange Surface 12:00		-364	-360	-362
26	QD Flange Surface 6:00		-385	-382	-383
37	OD Flex Hose 6:00	65	60	67	61
38	Conical Portion Vent Gas	37	39	35	29
39	OD Shroud Front 6:00	82	96	92	82
41	OD Conical Portion 6:00	68	69	70	65

IRN Revision C, Figure 3.3-2.9

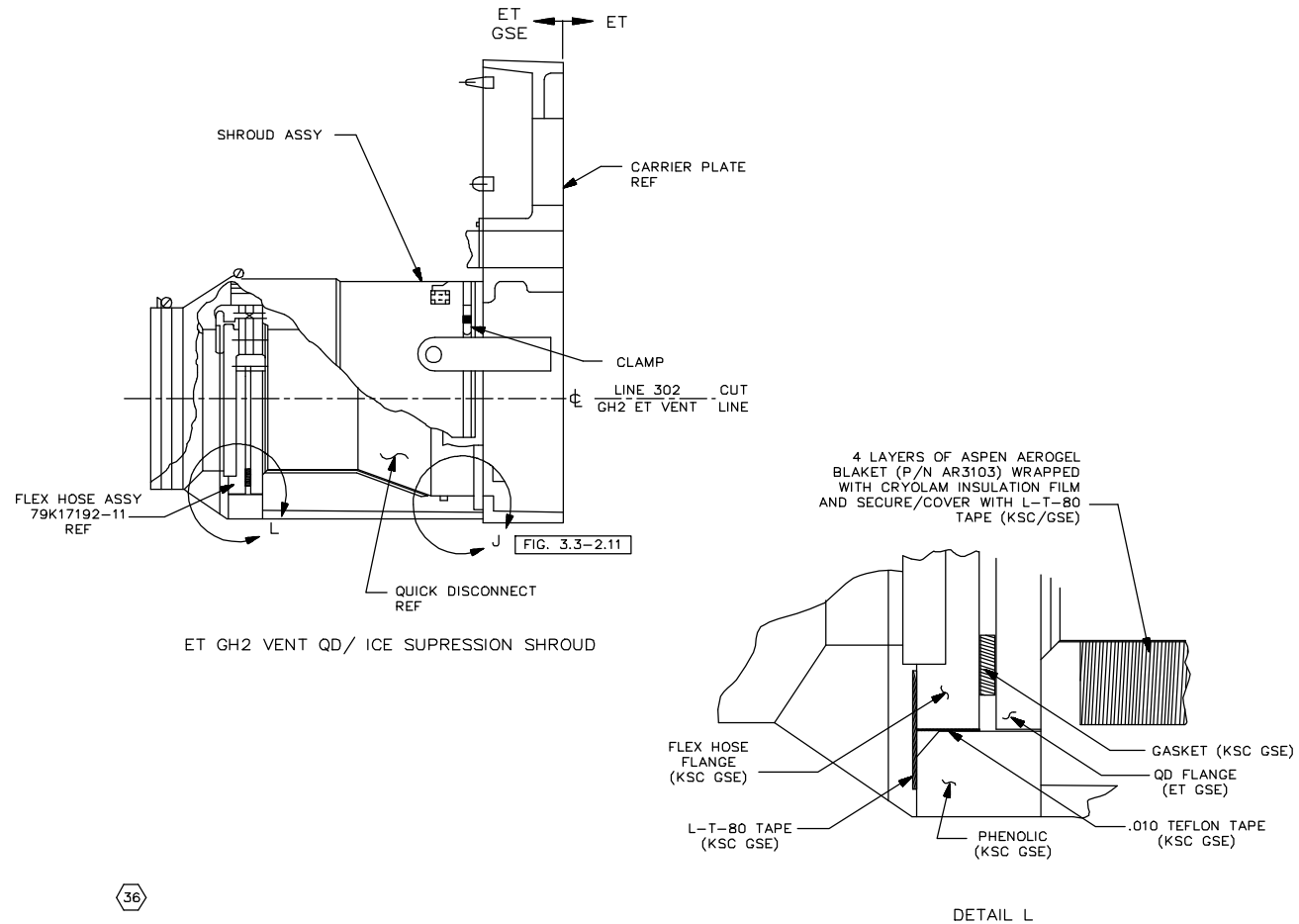
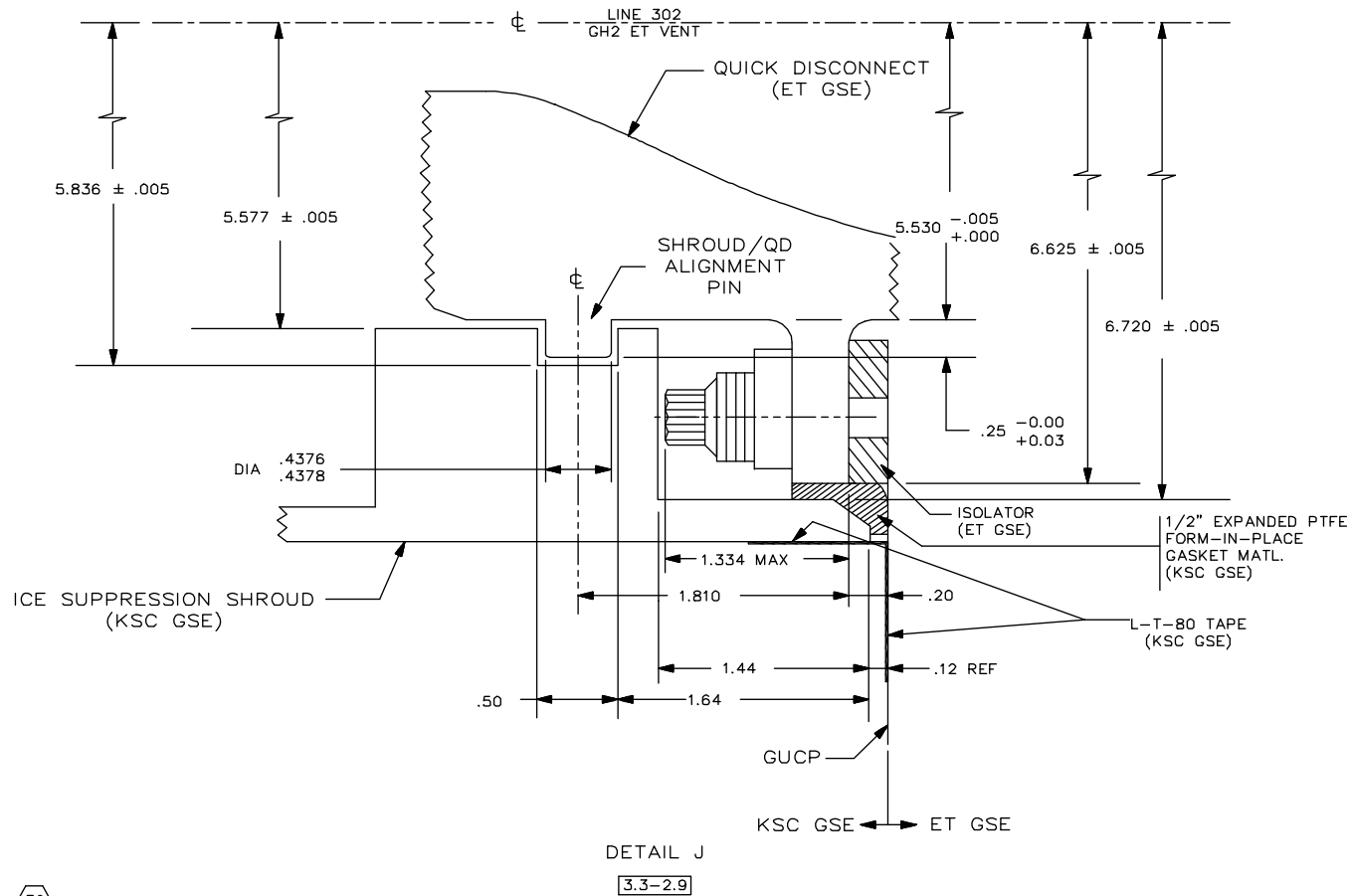


FIGURE 3.3-2.9 ET-1 GH2 VENT QD ICE SUPPRESSION

IRN Revision C, Figure 3.3-2.9 Detail J



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